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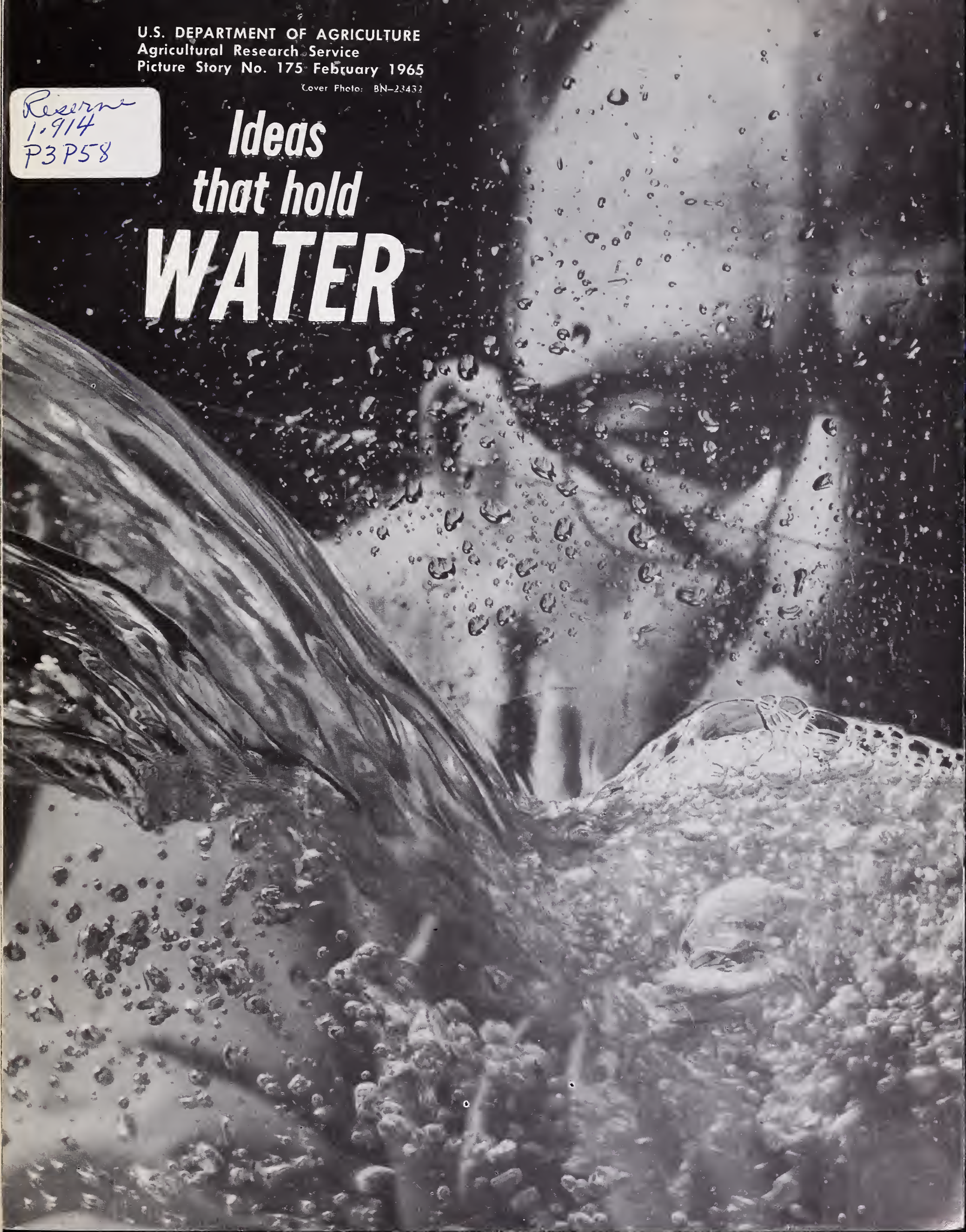
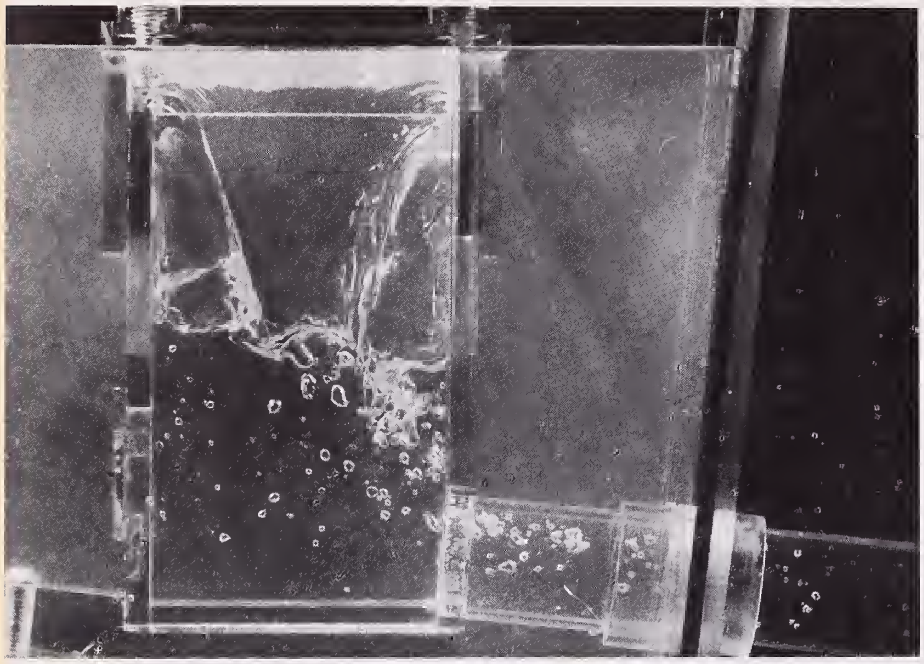
Ideas that hold WATER





Flowing water can be seen through clear plastic in this model of a drop inlet. These structures are used to let water enter a pipe or culvert from a pond or other body of water. This drop inlet is designed with plates to prevent the formation of vortices—the swirling of water often observed when draining a bathtub. When the spillway is in full operation, no air will mix with the water that enters the drop inlet. BN–21356

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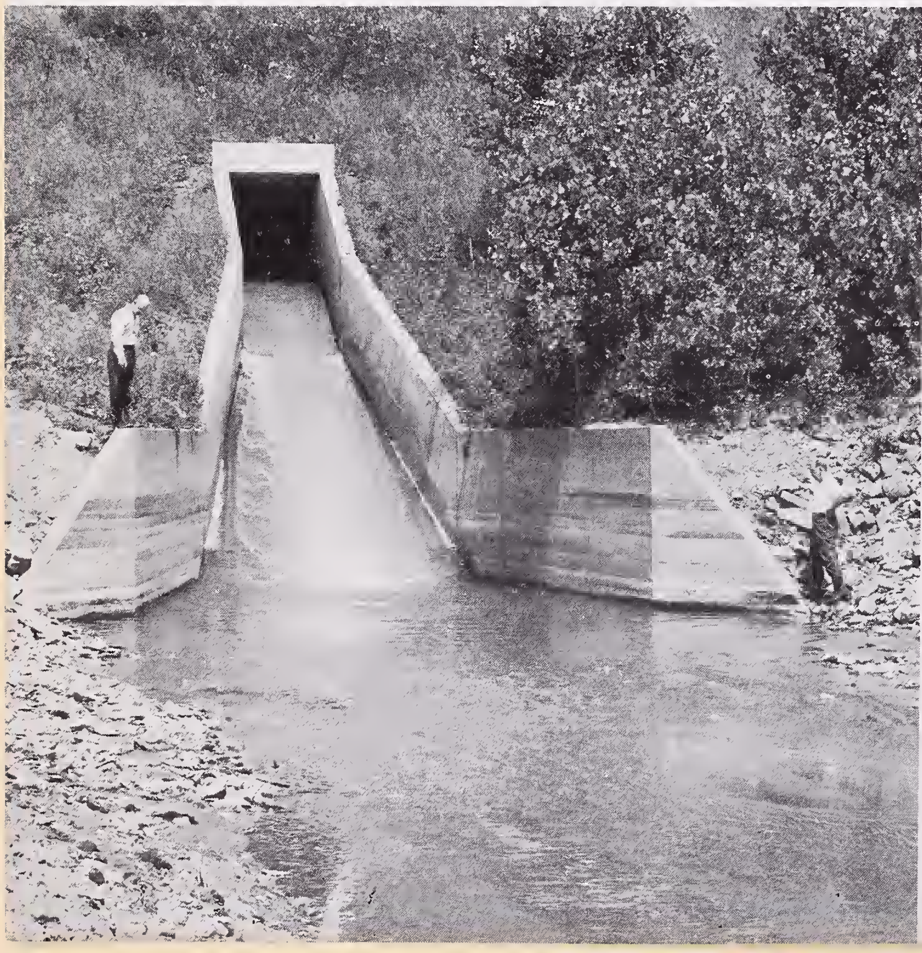
Research at the St. Anthony Falls laboratory led to the construction of a single culvert, 72 inches in diameter, under a Minnesota highway where plans originally called for two 108–inch culverts. The single culvert was much lower in cost.

The 72–inch culvert proved adequate because it incorporated a modification of a hood inlet developed for use on farm ponds and on streams for upstream flood protection. The modified inlet insures capacity flow of water through the culvert. Without the hood inlet, air would be sucked in with the water and would prevent the pipe from filling completely.

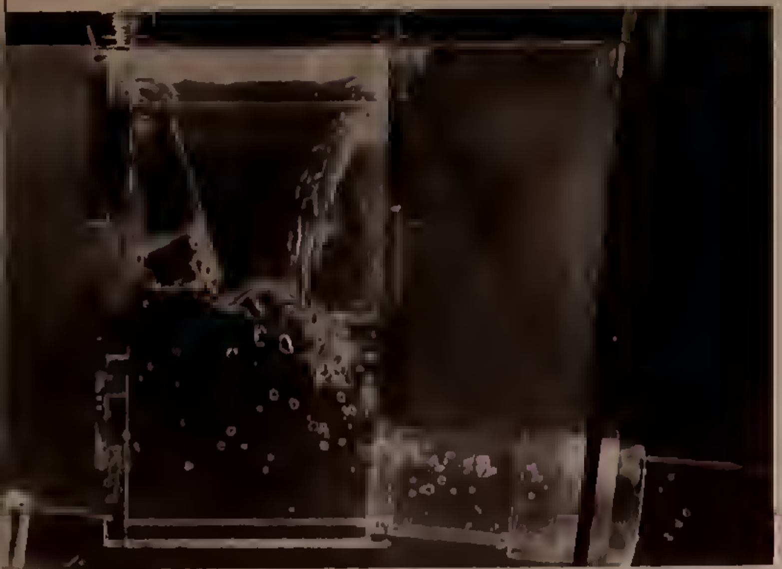
The exit of the culvert uses the SAF stilling basin, also developed at, and named for the St. Anthony Falls laboratory. This structure prevents water leaving the culvert from eroding the bed and banks of the waterway. It is smaller and less costly than other structures performing the same function.

Research findings have made it possible to lay farm drainage tile more quickly and at less cost. Formerly, engineers thought it necessary to join lateral, or side, lines to the main line at a 45–degree angle or less for

This hood inlet—in which modifications recommended by personnel at the St. Anthony Falls laboratory were incorporated—leads to a 72–inch culvert under Minnesota Highway 5, near the entrance to the Minneapolis–St. Paul International Airport. Plans originally called for two 108–inch culverts at this site. BN–23419



At the exit of the 72–inch culvert is a stilling basin of a type designed at the St. Anthony Falls laboratory, which prevents water rushing out of the culvert from eroding the stream bed and the banks. BN–23418



Flowing water can be seen through clear plastic in this model of a drop inlet. These structures are used to let water enter a pipe or culvert from a pond or other body of water. This drop inlet is designed with plates to prevent the formation of vortices—the swirling of water often observed when draining a bathtub. When the spillway is in full operation, no air will mix with the water that enters the drop inlet. BN-21356

More efficient, less costly methods of water control are being developed by the U. S. Department of Agriculture at the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota. Using plastic models and mathematical formulas in a multi-storied building on an island in the Mississippi River at Minneapolis, hydraulic engineers of the Agricultural Research Service develop principles that are applied across the country by the Soil Conservation Service on watershed-protection and flood-control projects, and by builders of farm ponds, reservoirs, and drainage systems throughout the world. This research is conducted in cooperation with the Laboratory and the Agricultural Experiment Station, University of Minnesota.

Hydraulic engineer C. A. Donnelly observes a model of the SAF stilling basin in operation. The downstream waterway is protected from erosion by this device. BN-23430

Research at the St. Anthony Falls laboratory led to the construction of a single culvert, 72 inches in diameter, under a Minnesota highway where plans originally called for two 108-inch culverts. The single culvert was much lower in cost.

The 72-inch culvert proved adequate because it incorporated a modification of a hood inlet developed for use on farm ponds and on streams for upstream flood protection. The modified inlet insures capacity flow of water through the culvert. Without the hood inlet, air would be sucked in with the water and would prevent the pipe from filling completely.

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Research findings have made it possible to lay farm drainage tile more quickly and at less cost. Formerly, engineers thought it necessary to join lateral, or side, lines to the main line at a 45-degree angle or less for the drainage system to function properly. This was a costly practice because, when such systems were constructed, the trenching machinery had to stand idle while workmen made a 45-degree junction by hand.

However, nearly 5,000 tests at the St. Anthony Falls laboratory of various junction angles showed that the 45-degree angle wasn't needed. The junction angle, the researchers learned, has virtually no effect on the performance of the drainage system. Laterals can be joined to the main at whatever angle is most convenient.

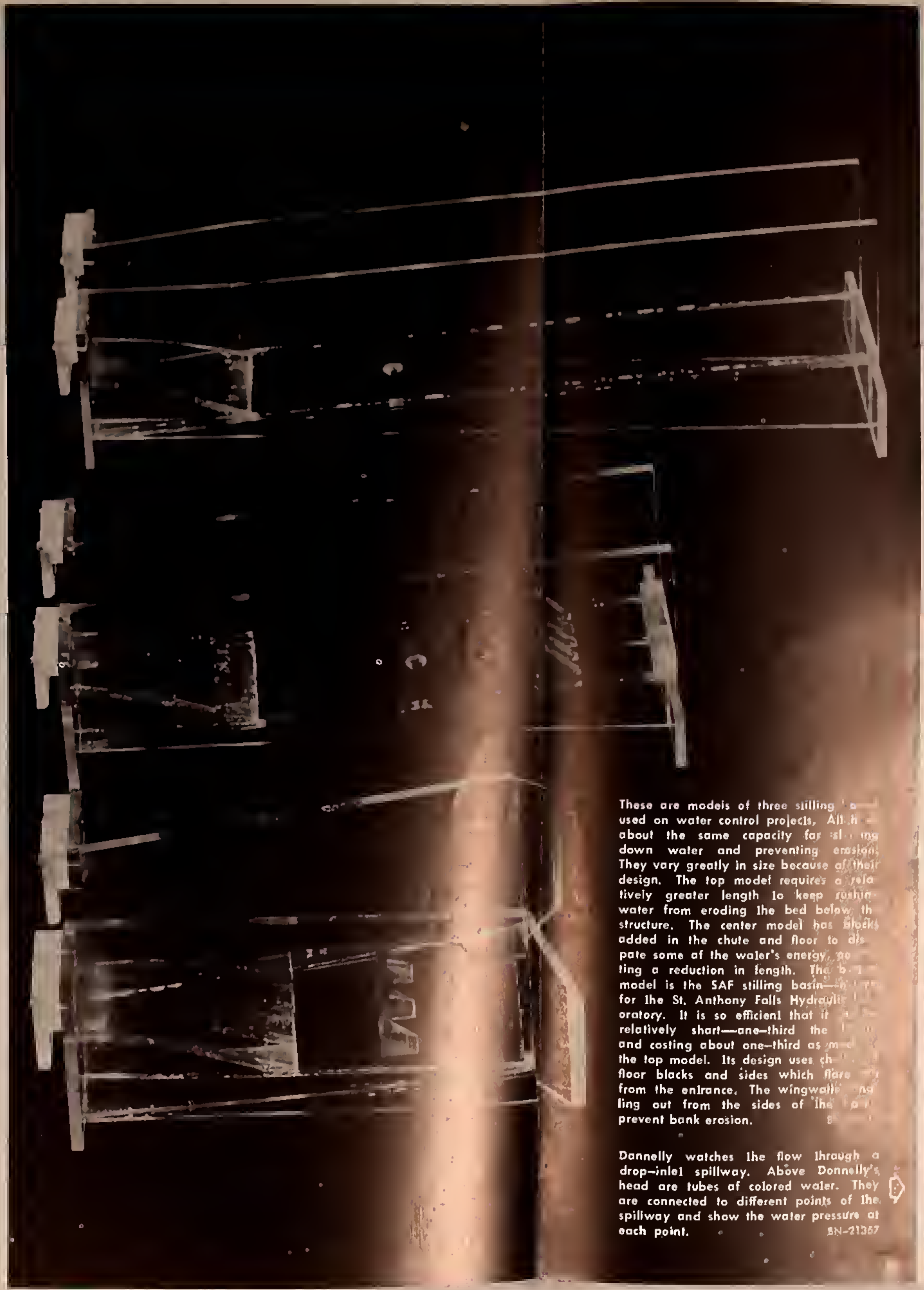
Experiments at the Hydraulic Laboratory are carried out in miniature, with clear plastic scale models to simulate the large final structures which are usually made of concrete or metal pipe. The action of the water can be seen and studied through the plastic, revealing how full a pipe is flowing and what direction the turbulence of the water is taking. Mechanical devices are used to measure and record water pressure at different points on the walls of the structures. Energy loss from friction is measured.

A downstream channel lined with sand enables the engineers to study erosion characteristics of spillways. A vertical plate can divide the spillway to form two "half-models." Changes can be made on one side of the model without affecting the other. Results of the changes can be observed by comparing erosion patterns in the sand downstream from each half-model.

Designs developed at the St. Anthony Falls laboratory can be adapted to any size structure—from one for use on a small farm pond to one for a massive reservoir. Many of the hydraulic principles established in this research can be applied to any structure handling other liquids or gases, such as city sewers, petroleum lines or air conditioning systems.

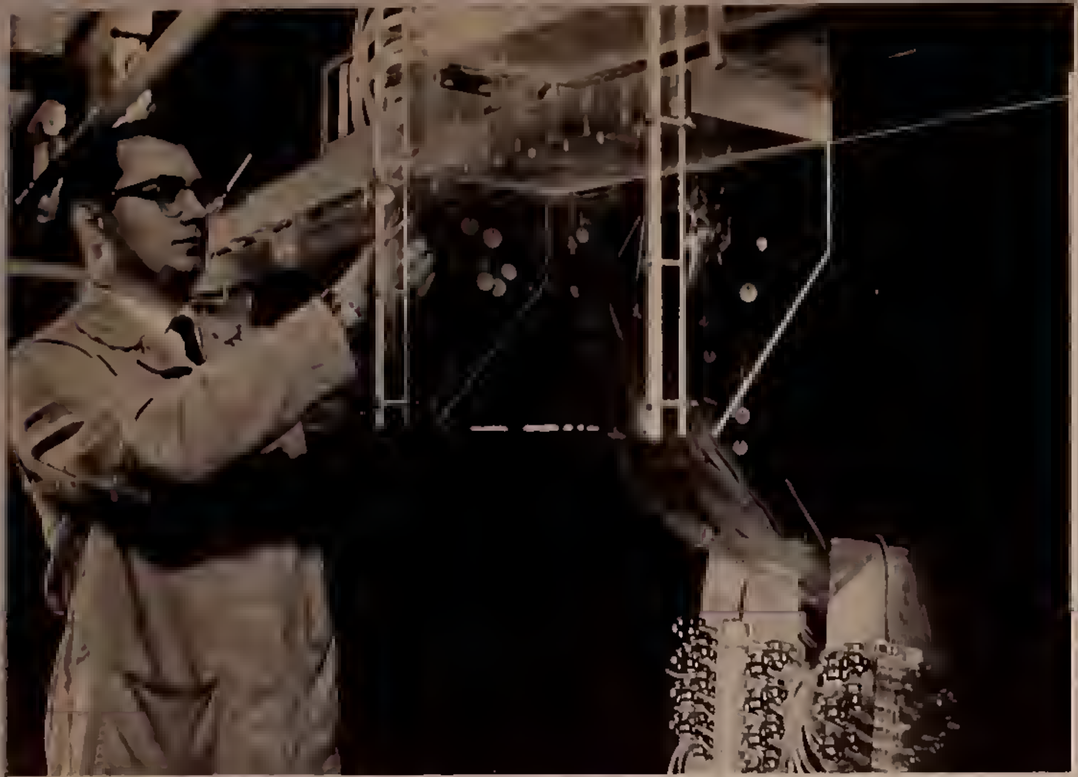
This hood inlet—in which modifications recommended by personnel at the St. Anthony Falls laboratory were incorporated—leads to a 72-inch culvert under Minnesota Highway 5, near the entrance to the Minneapolis–St. Paul International Airport. Plans originally called for two 108-inch culverts at this site. BN-23419

At the exit of the 72-inch culvert is a stilling basin of a type designed at the St. Anthony Falls laboratory, which prevents water rushing out of the culvert from eroding the stream bed and the banks. BN-23418



These are models of three stilling [illegible] used on water control projects. All [illegible] about the same capacity for sl[illegible] down water and preventing erosion. They vary greatly in size because of their design. The top model requires a relatively greater length to keep rushing water from eroding the bed below th[illegible] structure. The center model has blocks added in the chute and floor to dis[illegible] pate some of the water's energy, [illegible] ting a reduction in length. The b[illegible] model is the SAF stilling basin—[illegible] for the St. Anthony Falls Hydraulic [illegible] oratory. It is so efficient that it [illegible] relatively short—one-third the [illegible] and costing about one-third as m[illegible] the top model. Its design uses ch[illegible] floor blocks and sides which flare [illegible] from the entrance. The wingwalls [illegible] ling out from the sides of the [illegible] prevent bank erosion.

Donnelly watches the flow through a drop-inlet spillway. Above Donnelly's head are tubes of colored water. They are connected to different points of the spillway and show the water pressure at each point. BN-21357



An air model of a two-way drop inlet is checked out by hydraulic engineer George Hebaus. For convenience, it is placed on its side; the real top, as it would work in water, is the large flat rectangular plate in the center of the picture. The tubes lead to a pressure gage. Air is pulled through the spillway (the round pipe running from the inlet to a point behind Hebaus) by a fan at the other end. BN-23433

Pressure at different points in the air model is punched on paper tape. A computer is used to speed analysis of the information. BN-23428

Because the flow of air through the models is similar to the flow of water, engineers have been able to substitute air for water in some tests. Experiments with air models are easier to set up, and results are obtained quicker. A fan is used to move air rather than a pump to recirculate water.

Air models can be used in tests to determine the amount of energy lost by friction in the structure. This energy loss slows down the velocity of the water. Therefore, less water can pass through the structure in a given period of time. Air can also be substituted in tests to determine pressure differences between the outside and inside of the structure at various points. Knowing these differences helps designers provide structures strong enough to withstand pressures encountered under peak operating conditions.

Hydraulic engineer F. W. Blaisdell holds a plastic model of a 45-degree tile junction used in a study of the effect of junction angle on the performance of farm drainage systems. Tests showed that laterals can be joined to the main at the most convenient angle. BN-20513

Tubes coming from the air-model drop inlet provide a means of measuring pressure at different points of the model. This information helps engineers design highly efficient inlets strong enough to withstand capacity flows. BN-23429

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